CLAIMS

What is claimed is:

1. An imaging system comprising:

an antenna apparatus configured to transmit toward and receive from a subject in a subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points including at least a first curved locus of points having a center of curvature spaced from the center of the subject position;

a transceiver configured to operate the antenna apparatus and produce an output representative of the received radiation; and

a processor adapted to convert the transceiver output into image data representative of an image of at least a portion of the subject.

2. A system according to claim 1, in which the center of the subject position is between the center of curvature of the curved locus of points and the associated locus of points.

3. A system according to claim 2, in which the antenna apparatus is adapted to move in a curved path along the curved locus of points.

4. A system according to claim 3, in which the antenna apparatus extends along the curved locus of points.

5. A system according to claim 4 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

6. A system according to claim 3 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

7. A system according to claim 3, in which the path along the curved locus of points has a plurality of different centers of curvature.

8. A system according to claim 2, in which the antenna apparatus extends along the curved locus of points.

9. A system according to claim 8 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject adjacent to the curved locus of points.

10. A system according to claim 8, in which the path along the curved locus of points has a plurality of different centers of curvature.

11. A system according to claim 2, in which the curved locus of points defines a first arc having opposite ends, and the subject position is closer to one end of the arc than the other end.

12. A system according to claim 11, in which the subject position is generally between the center of curvature of the curved locus of points and the one end of the arc.

13. A system according to claim 11, in which the antenna apparatus is further configured to transmit and receive electromagnetic radiation distributed along a second locus of points spaced from the first locus of points, the second locus of points including a second curved locus of points forming a second arc having a center of curvature and opposite ends, and the subject position is closer to one end of the second arc than the other end of the second arc.

14. A system according to claim 13, in which the subject position is between the first and second arcs.

15. A system according to claim 14, in which a line connecting the one end of the first arc with the one end of the second arc passes through the object position.

16. A system according to claim 13, in which the first and second arcs form a generally S-shaped subject passageway.

17. A system according to claim 1, in which the center of curvature of the curved locus of points and the antenna apparatus are on the same side of the center of the subject position.

18. A system according to claim 17, in which the center of curvature of the curved locus of points is between the center of the subject position and the antenna apparatus.

19. A system according to claim 18, in which the antenna apparatus is adapted to move in a curved path along the curved locus of points.

20. A system according to claim 19, in which the antenna apparatus is curved along the curved locus of points.

21. A system according to claim 20 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

22. A system according to claim 19, in which the antenna apparatus includes first antenna array moving in a first arc defining a first curved locus of points and a second antenna array moving in a second arc defining a second curved locus of points, the first and second arcs having respective centers of curvature positioned between the center of the subject position and the respective antenna array.

23. A system according to claim 22, further comprising an array-apparatus moving mechanism adapted to move the first antenna array between a distal position and a proximal position, the array being closer to the subject position when in the proximal position than when in the distal position.

24. A system according to claim 19 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

25. A system according to claim 18, in which the antenna apparatus extends along the curved locus of points.

26. A system according to claim 25, in which the antenna apparatus includes a first antenna array moving in a first arc defining a first curved locus of points and a second antenna array moving in a second arc defining a second curved locus of points, the first and second arcs having respective centers of curvature positioned between the center of the subject position and the respective antenna array.

27. A system according to claim 26, further comprising an array-apparatus moving mechanism adapted to move the first antenna array between a distal position and a proximal position, the array being closer to the subject position when in the proximal position than when in the distal position.

28. A system according to claim 25 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

29. A system according to claim 25, in which the antenna apparatus includes at least one antenna unit, and each antenna unit pivots about a pivot axis spaced from the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

30. A system according to claim 18, in which the antenna apparatus includes at least one antenna unit, and each antenna unit pivots about a pivot axis spaced from the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

31. A system according to claim 30, in which each antenna unit pivots about a fixed pivot axis.

32. A system according to claim 18, in which the locus of points has a plurality of centers of curvature.

33. A system according to claim 17, in which the antenna apparatus is between the center of the subject position and the center of curvature of the curved locus of points.

34. A system according to claim 33, in which the antenna apparatus includes at least one antenna unit, and each antenna unit pivots about a pivot axis spaced from the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

35. A system according to claim 34, in which each antenna unit pivots about a fixed pivot axis.

36. A system according to claim 33, in which the locus of points has a plurality of different centers of curvature.

37. A system according to claim 33, in which the curved locus of points is convex when viewed from the subject position.

38. A system according to claim 17, in which the antenna apparatus includes at least one antenna unit, and each antenna unit pivots about a pivot axis substantially on the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

39. A system according to claim 38, in which each antenna unit pivots about a fixed pivot axis.

40. A system according to claim 17, in which the antenna apparatus includes at least one antenna unit, and each antenna unit pivots about a pivot axis substantially passing through the antenna unit, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

41. A system according to claim 40, in which each antenna unit pivots about a fixed pivot axis.

42. A system according to claim 1, in which the locus of points has a plurality of different centers of curvature.

43. A system according to claim 42, in which the locus of points has an intermediate curved portion and an end curved portion on each end of the intermediate curved portion, with the intermediate curved portion having a longer radius of curvature than the radius of curvature of the end portions.

44. A system according to claim 43 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the locus of points has a curve corresponding to the shape of the subject facing the curved locus of points.

45. A system according to claim 42, in which the locus of points has an intermediate curved portion and an end portion on each end of the intermediate curved portion that is angled toward the center of the subject position relative to the intermediate curved portion

46. A system according to claim 45, in which the end portions are rectilinear.

47. A system according to claim 45, in which the end portions are curved, with the intermediate curved portion having a shorter radius of curvature than the radius of curvature of the end portions.

48. A system according to claim 45 for use on a subject having an eccentric shape relative to the center of the subject position, and in which the intermediate portion and end portions have a combined shape corresponding to the shape of the subject facing the intermediate and end portions.

49. An imaging system comprising:

an antenna apparatus configured to transmit toward and receive from a subject in a subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points including at least a first curved locus of points having a center of curvature and defining a first arc having opposite ends, with the subject position being closer to one end of the arc than the other end;

a transceiver configured to operate the antenna apparatus and produce an output representative of the received radiation; and

a processor adapted to convert the transceiver output into image data representative of an image of at least a portion of the subject.

50. A system according to claim 49, in which the subject position is generally between the center of curvature of the curved locus of points and the one end of the arc.

51. A system according to claim 50, in which the antenna apparatus is further configured to transmit and receive electromagnetic radiation distributed along a second locus of points spaced from the first locus of points, the second locus of points including a second curved locus of points forming a second arc having a center of curvature and opposite ends, and the subject position is closer to one end of the second arc than the other end of the second arc.

52. A system according to claim 51, in which the subject position is between the first and second arcs.

53. A system according to claim 52, in which a line connecting the one end of the first arc with the one end of the second arc passes through the object position.

54. A system according to claim 53, in which the line also passes through the other end of the first arc and the other end of the second arc.

55. A system according to claim 53, in which the one end of each of the first and second arcs is adjacent to the center of the other of the first and second arcs.

56. An imaging system comprising:

an array of antenna units configured to transmit toward and receive from a subject in a subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed in the array along at least a line, each antenna unit being oriented at a fixed angle to the line of the array, at least one antenna unit being oriented at an acute angle to the line of the array;

a transceiver configured to operate the antenna apparatus and produce an output representative of the received radiation; and

a processor adapted to convert the transceiver output into image data representative of an image of at least a portion of the subject.

57. A system according to claim 56, in which the line of the array is rectilinear.

58. A system according to claim 56, in which the line of the array is at least partially curved.

59. A system according to claim 58, in which the line of the array includes an arc having a center of curvature spaced from the subject position, and a plurality of antenna units disposed along the arc are oriented at an acute angle relative to the arc.

60. A system according to claim 59, in which the antenna units disposed along the arc are oriented generally toward the subject position.

61. A system according to claim 56, in which the angles of antenna units vary along a length of the array.

62. A system according to claim 56, in which at least a portion of the antenna units are oriented generally toward the subject position.

63. A system according to claim 56, in which the array is two-dimensional.

64. A system according to claim 63, in which the array is planar.

65. A system according to claim 63, in which the array extends in at least one direction along a curved line.

66. A system according to claim 65, in which the angles of antenna units vary along a length of the array.

67. An imaging system comprising:

an array of antenna units configured to transmit toward and receive from a subject in a subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed in the array along at least a line, each antenna unit having a given orientation on the line of the array, at least two antenna units having different orientations on the line of the array;

a transceiver configured to operate the antenna apparatus and produce an output representative of the received radiation; and

a processor adapted to convert the transceiver output into image data representative of an image of at least a portion of the subject.

68. A system according to claim 67, in which at least two antenna units have different circumferential orientations on the line of the array.

69. A system according to claim 68, in which the at least one of the at least two antenna units is also oriented at an acute angle to the line of the array.

70. A system according to claim 67, in which the at least one of the at least two antenna units is also oriented at an acute angle to the line of the array.

71. An imaging system comprising:

a first antenna apparatus configured to transmit toward and receive from a subject in a subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points;

a first moving mechanism adapted to move the antenna apparatus along a first antenna path;

a second moving mechanism adapted to move the first moving mechanism and the antenna apparatus in a manner moving the antenna path in a direction transverse to the antenna path, between a first path position and a second path position; and

a controller configured to operate the antenna apparatus when the antenna path is in the second path position, and to produce image data representative of an image of at least a portion of the subject.

72. A system according to claim 71, further comprising a second antenna apparatus configured to transmit toward and receive from a subject in the subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a second locus of points spaced from the first locus of points, the second moving mechanism moving the first moving mechanism and the first antenna apparatus relative to the second antenna apparatus, and the controller configured to operate the second antenna apparatus.

73. A system according to claim 72, further comprising a third moving mechanism adapted to move the second antenna apparatus along a second antenna path.

74. A system according to claim 73, in which the first and second antenna paths are on opposite sides of the subject position.

75. An imaging system comprising:

an antenna apparatus configured to transmit toward and receive from a subject in a subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points;

a first moving mechanism adapted to move the antenna apparatus along a first antenna path;

a second moving mechanism adapted to move the first moving mechanism and the antenna apparatus in a manner moving the antenna path in a continuous loop around the subject position; and

a controller configured to operate the antenna apparatus, when the antenna path is in different positions around the loop, and first and second moving mechanisms, and to produce image data representative of an image of at least a portion of the subject.

76. A system according to claim 75, in which the subject is a person, the system including a continuous subject path passing through the subject position and a barrier extending along the first antenna path, and in which the second moving mechanism is adapted to move the barrier with the antenna apparatus and the first moving mechanism, the controller further being configured to operate the second moving mechanism to position the barrier on the subject path downstream from the subject position prior to initiating operation of the antenna apparatus, and to position the barrier away from the subject path downstream from the subject position after initiating operation of the antenna apparatus.

77. An imaging system comprising:

first and second antenna apparatus configured to transmit toward and receive from a subject in a subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from respective positions spaced from the subject position;

a first moving mechanism adapted to move the first antenna apparatus along a first antenna path;

a second moving mechanism adapted to move the second antenna apparatus along a second antenna path spaced from the first antenna path;

a third moving mechanism adapted to move the first moving mechanism and the first antenna apparatus in a first direction around the subject position, and adapted to move the second moving mechanism and the second antenna apparatus in a second direction opposite the first direction around the subject position; and

a controller configured to operate the antenna apparatus, when the antenna path is in different positions around the loop, and first and second moving mechanisms, and to produce image data representative of an image of at least a portion of the subject.

78. A system according to claim 77, in which the controller is configured to operate the third moving mechanism to move the first and second antenna apparatus between a first antenna position in which the first and second antenna apparatus are adjacent each other and a second antenna position spaced from the first antenna position.

79. A system according to claim 78, in which the first and second antenna apparatus are also adjacent each other in the second antenna position.

80. A system according to claim 79, in which the subject is a person, the system including a continuous subject path passing through the subject position, a first barrier extending along the first antenna path, and a second barrier extending along the second antenna path, the first and second barriers being adjacent to each other on the subject path downstream from the subject position in the first antenna position, and being adjacent to each other on the subject path upstream from the subject position in the second antenna position.

81. An imaging system comprising:

an antenna apparatus configured to transmit toward and receive from a subject in a subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first arc having opposite ends, and the subject position is closer to one end of the arc than the other end;

a transceiver configured to operate the antenna apparatus and produce an output representative of the received radiation; and

a processor adapted to convert the transceiver output into image data representative of an image of at least a portion of the subject.

82. A system according to claim 81, in which the arc has a center of curvature, and the subject position is generally between the center of curvature of the arc and the one end of the arc.

83. A system according to claim 81, in which the antenna apparatus is further configured to transmit and receive electromagnetic radiation distributed along a second arc spaced from the first arc, the second arc having a center of curvature and opposite ends, and the subject position is also closer to one end of the second arc than the other end of the second arc.

84. A system according to claim 83, in which the subject position is between the first and second arcs.

85. A system according to claim 84, in which a line connecting the one end of the first arc with the one end of the second arc passes through the object position.

86. A method of imaging comprising:

transmitting toward a subject in a subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points including at least a first curved locus of points having a center of curvature spaced from the center of the subject position;

receiving from the subject reflected electromagnetic radiation;

producing an output representative of the received radiation; and

converting the output into image data representative of an image of at least a portion of the subject.

87. A method according to claim 86, in which transmitting radiation includes transmitting radiation from an antenna apparatus, and receiving radiation includes receiving information on an antenna apparatus, the method further comprising moving the antenna apparatus in a curved path along the curved locus of points.

88. A method according to claim 87, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a center of curvature on the opposite side of the center of the subject position from the antenna apparatus.

89. A method according to claim 87, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points corresponding to a shape of a subject that is eccentric relative to the center of the subject position.

90. A method according to claim 87, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a plurality of centers of curvature.

91. A method according to claim 90, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a plurality of different centers of curvature.

92. A method according to claim 86, in which the curved locus of points defines a first arc having opposite ends, the method further comprising positioning the subject position closer to one end of the arc than the other end.

93. A method according to claim 92, in which transmitting radiation includes transmitting radiation from positions distributed along a second locus of points spaced from the first locus of points, the second locus of points including a second curved locus of points forming a second arc having a center of curvature and opposite ends, and positioning the subject position includes positioning the subject position closer to one end of the second arc than the other end of the second arc.

94. A method according to claim 87, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a center of curvature on the same side of the center of the subject position as the antenna apparatus.

95. A method according to claim 94, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a center of curvature between the center of the subject position and the antenna apparatus.

96. A method according to claim 95, in which the antenna apparatus includes a first antenna array and a second antenna array, and moving the antenna apparatus includes moving the first antenna array in a first arc and moving the second antenna array in a second arc, the first and second arcs having respective centers of curvature positioned between the center of the subject position and the respective antenna array.

97. A method according to claim 96, further comprising moving the first antenna array between a distal position and a proximal position, the array being closer to the subject position when in the proximal position than when in the distal position.

98. A method according to claim 94, in which the antenna apparatus includes a first antenna array and a second antenna array, and moving the antenna apparatus includes moving the first antenna array in a first arc and moving the second antenna array in a second arc, the first and second arcs having respective centers of curvature positioned between the center of the subject position and the respective antenna array.

99. A method according to claim 98, further comprising moving the first antenna array between a distal position and a proximal position, the array being closer to the subject position when in the proximal position than when in the distal position.

100. A method according to claim 94, in which the antenna apparatus includes at least one antenna unit, and moving the antenna apparatus includes pivoting each antenna unit about a pivot axis corresponding to the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

101. A method according to claim 100, in which pivoting each antenna unit includes pivoting each antenna unit about a fixed pivot axis.

102. A method according to claim 88, in which moving the antenna apparatus includes moving the antenna apparatus along a curved locus of points having a center of curvature on a side of the antenna apparatus opposite from the center of the subject position.

103. A method according to claim 102, in which the antenna apparatus includes at least one antenna unit, and moving the antenna apparatus includes pivoting each antenna unit about a pivot axis corresponding to the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

104. A method according to claim 103, in which pivoting each antenna unit includes pivoting each antenna unit about a fixed pivot axis.

105. A method according to claim 86, in which transmitting radiation includes transmitting radiation along a curved locus of points having a plurality of different centers of curvature.

106. A method according to claim 105, in which transmitting radiation includes transmitting radiation along a locus of points having an intermediate curved portion and an end curved portion on each end of the intermediate curved portion, with the intermediate curved portion having a longer radius of curvature than the radius of curvature of the end portions.

107. A method according to claim 106, in which transmitting radiation includes transmitting radiation from an antenna apparatus, and receiving radiation includes receiving information on an antenna apparatus, the method further comprising moving the antenna apparatus in a curved path along the end and intermediate curved portions of the locus of points during transmitting and receiving.

108. A method of imaging comprising:

transmitting from a transmission position spaced from a subject position toward a subject in the subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz;

scanning the radiation transmitted from the transmission position across at least a portion of the subject position;

receiving from the subject reflected electromagnetic radiation;

producing an output representative of the received radiation; and

converting the output into image data representative of an image of at least a portion of the subject.

109. A method according to claim 108, in which transmitting radiation includes transmitting radiation from at least one antenna unit, and scanning the radiation includes pivoting each antenna unit about a pivot axis.

110. A method according to claim 109, in which pivoting each antenna unit includes pivoting each antenna unit about a fixed pivot axis.

111. A system of imaging comprising:

means for transmitting toward a subject in a subject position having a center, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz, from positions spaced from the subject position and distributed along a first locus of points including at least a first curved locus of points having a center of curvature spaced from the center of the subject position;

means for receiving from the subject reflected electromagnetic radiation;

means for producing an output representative of the received radiation; and

means for converting the output into image data representative of an image of at least a portion of the subject.

112. A system according to claim 111, in which the means for transmitting radiation includes an antenna apparatus, and the means for receiving radiation includes the antenna apparatus, the system further comprising means for moving the antenna apparatus in a curved path along the curved locus of points during transmitting and receiving.

113. A system according to claim 112, in which the means for moving the antenna apparatus is further for moving the antenna apparatus along a curved locus of points having a center of curvature on the opposite side of the center of the subject position from the antenna apparatus.

114. A system according to claim 112, in which the means for moving the antenna apparatus is further for moving the antenna apparatus along a curved locus of points corresponding to a shape of a subject that is eccentric relative to the center of the subject position.

115. A system according to claim 112, in which the means for moving the antenna apparatus is further for moving the antenna apparatus along a curved locus of points having a plurality of centers of curvature.

116. A system according to claim 112, in which the means for moving the antenna apparatus is further for moving the antenna apparatus along a curved locus of points having a center of curvature on a side of the antenna apparatus opposite from the center of the subject position.

117. A system according to claim 116, in which the antenna apparatus includes at least one antenna unit, and the means for moving the antenna apparatus is further for pivoting each antenna unit about a pivot axis corresponding to the center of curvature of the curved locus of points, whereby each antenna unit scans across at least a portion of the subject position as the antenna unit pivots about the pivot axis.

118. A system according to claim 111, in which the means for transmitting radiation is further for transmitting radiation along a curved locus of points having a plurality of different centers of curvature.

119. A system of imaging comprising:

means for transmitting from a transmission position spaced from a subject position toward a subject in the subject position, electromagnetic radiation in a frequency range of about 200 MHz to about 1 THz;

means for scanning the radiation transmitted from the transmission position across at least a portion of the subject position;

means for receiving from the subject reflected electromagnetic radiation;

means for producing an output representative of the received radiation; and

means for converting the output into image data representative of an image of at least a portion of the subject.

120. A system according to claim 119, in which the means for transmitting radiation is further for transmitting radiation from at least one antenna unit, and scanning the radiation includes pivoting each antenna unit about a pivot axis.